Traffic Analysis and Collision Pattern (Vision Zero)

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Abstract

This analysis will primarily focus on the number of collisions before and after NYC adopting Vision Zero. In this analysis, the statistical model of K-S testing will be used to compare the two periods; before and after the adoption of Vision Zero. The study will include a time series of the effectiveness of Vision Zero using the data; based on the cumulative number of accidents. The cumulative number and daily pattern of the collisions will measure probabilities of effectiveness.

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A reproducible notebook can be accessed through Github link

Introduction

General History and outlines of Vision Zero

In 1997, Sweden implemented Vision Zero with a set goal to reach a transportation network with no fatalities or serious injuries. The central principle for Sweden was "Life and health can never be exchanged for other benefits within society." This goal is to create and enforce safety, targeting different modes such as Pedestrian, cyclist, and vehicle. Furthermore, Vision Zero was adopted by many countries and cities: Netherlands, United Kingdom and recently, cities within the United States like Boston, San Francisco, California, and New York City. In 2014, Mayor de Blasio released a New York City Vision Zero Action plan, a 63 steps-disciplined approach to achieve the goals of Vision Zero. The goals are to reduce the numbers of fatalities by combining three main characteristics elements to assure safety: process and development enforcement, education and engineering to make sure that New York City is working toward achieving Vision Zero.

NYC Vision Zero

NYC Vision Zero is a safety program have an ideal proposal to eliminate all traffic death and serious injuries. It also incorporates the collaborations with different Transportation associate agencies in the city:

City Hall, Police Department, Department of Transportation, Taxi and Limousine Commission, Department of Citywide Administrative Services and Department of Health and Mental Hygiene. These departments will be working together setting up rules and regulations to improve the safety of the action plan. The plan will include the following: more enforcement against speeding with more precinct-level personnel, adding personnel at the Highway Division of the NYPD. Also, redesigning intersections and expanding upon the slow zone in residential neighborhood and school zone.

Most importantly and effectively is the increase in the number of speed humps, speed boards, red lights, and speed cameras to ensure the vehicles are following the rules and regulations. Please note: the data set used in this report is from NYPD Collision Reports. Nonetheless, other agencies have their input in organizing and finding mitigation measures.

Some of the mitigation measures include related to some of the main contributing factors to collision within the five boroughs.

1. Implement safety engineering improvements at 50 intersections and corridors
2. Create 25 new arterial slow zones
3. Install speed cameras at 20 new authorized locations
4. Install 250-speed bumps, including in neighborhood slow zones
5. Enhance maintenance of street markings
6. Additional street reconstruction safety projects
7. Survey national and international best practices to expand potential strategies
8. Undertake a high-quality ad campaign aimed at reducing speeding, failure-to-yield and other forms of reckless driving
9. Increase extent of “Choices” anti-DUI campaign
10. Double number of programmable speed boards for intensive education/enforcement initiative
11. Make effective, age-appropriate safety curriculum available to schools throughout the city
12. Partner with senior centers to increase communication and get specific feedback from aging New Yorkers about street safety improvements
13. Increase the number and visibility of hands-on safety demonstrations
14. Add safety flyers and messaging in DOT mailings such as Alternate Side Parking regulations and construction permits

Historical Event:

Traffic fatalities in NYC have significantly decreased from 701 in 1990 to 381 in 2000. In 2011 it reached 249 deaths making New York, globally seen as a foremost innovator in safe street design. Nevertheless, about 4,000 New Yorkers are still severely harmed, and more than 250 killed in traffic crashes yearly. January 2014, Mayor Deplasio launched Vision Zero to improve street safety in all NYC area.

Before the adoption of Vision Zero, in 2012 Hurricane Sandy struck NYC and damaged the infrastructure of the street. Hurricane Sandy caused extensive impacts to infrastructure causing closures of all major transportation arteries into the city on October 31 to November 1, 2012. A potential reason that we see a slow progress of improvement with the adoption of Vision Zero, Hurricane Sandy might have been a contributing factor to the slow progress.

Vision Zero Data:

The data used for this analysis driven from:

NYC Open Data NYPD Motor Vehicle Collison. (https://data.cityofnewyork.us/api/views/h9gi-nx95/rows.csv?accessType=DOWNLOAD)

1. Filtered the data set to before and after the adoption of Vision Zero
2. Used the cumulative number of accident per day
3. Using a time frame using Year, Month and Day (To create the time series plot)

Used the following the link for understandings:

https://www1.nyc.gov/site/visionzero/index.page

http://www.nyc.gov/html/dot/html/about/datafeeds.shtml#vision

Methodology:

To investigate the effectiveness of Vision Zero, a **Kolmogorov-Smirnov (K-S) test** is employed. KS-test tests whether two samples are drawn from the same distribution or if the two samples differ significantly from each other. The null hypothesis in the K-S statistic is that the distribution of the two samples is the same.

K-S test is employed for the following reasons:

1. The test is distribution-free, thus giving valid probabilities for any underlying distribution of the two samples.
2. It can be universally applied without restriction to any problem.
3. Critical values of probabilities are widely available.
4. The statistic is easy to compute.

Applying to the Vision Zero case, the Null hypothesis is that the distribution of the number of daily accidents before Vision Zero adoption and after Vision Zero adoption is the same. We reject the Null hypothesis if the resulting p-value from the test is less than the critical value 0.01.

A **point of change analysis** is also conducted to assess if the Vision Zero implementation date corresponds to a point in time when there is a significant difference between the mean number of daily accidents before and after the point. This will help assess if the Vision Zero implementation date coincides with the point in time where the rate of daily accidents increases/decreases.

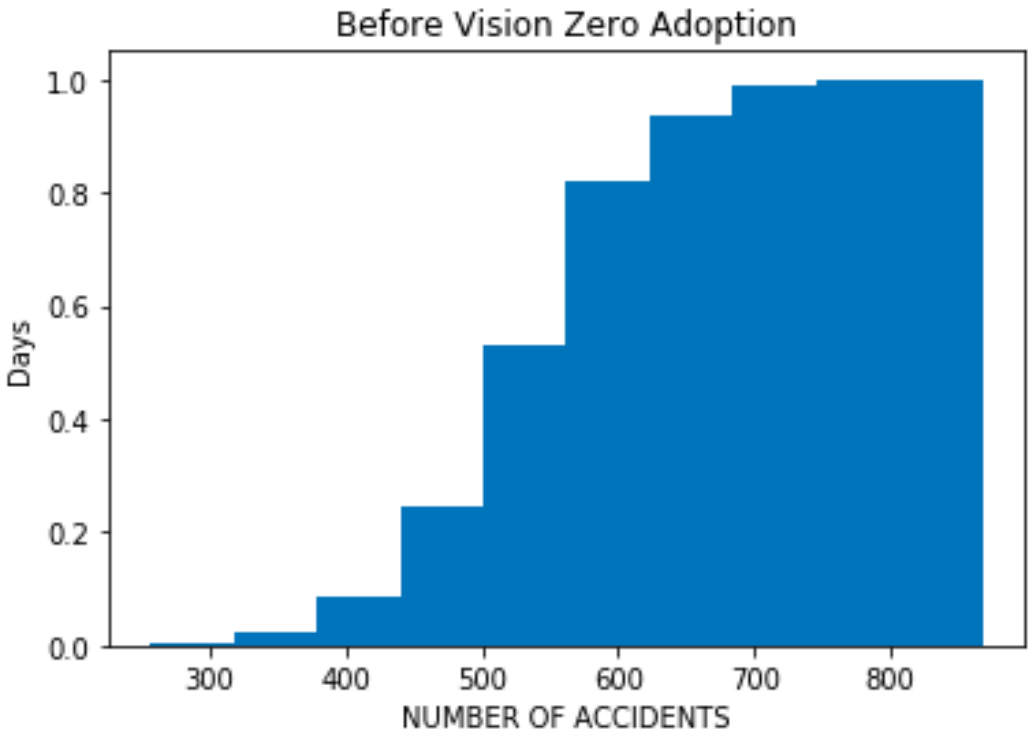

Figure 1: Cumulative Frequency of Daily Number of Accidents Before Vision Zero

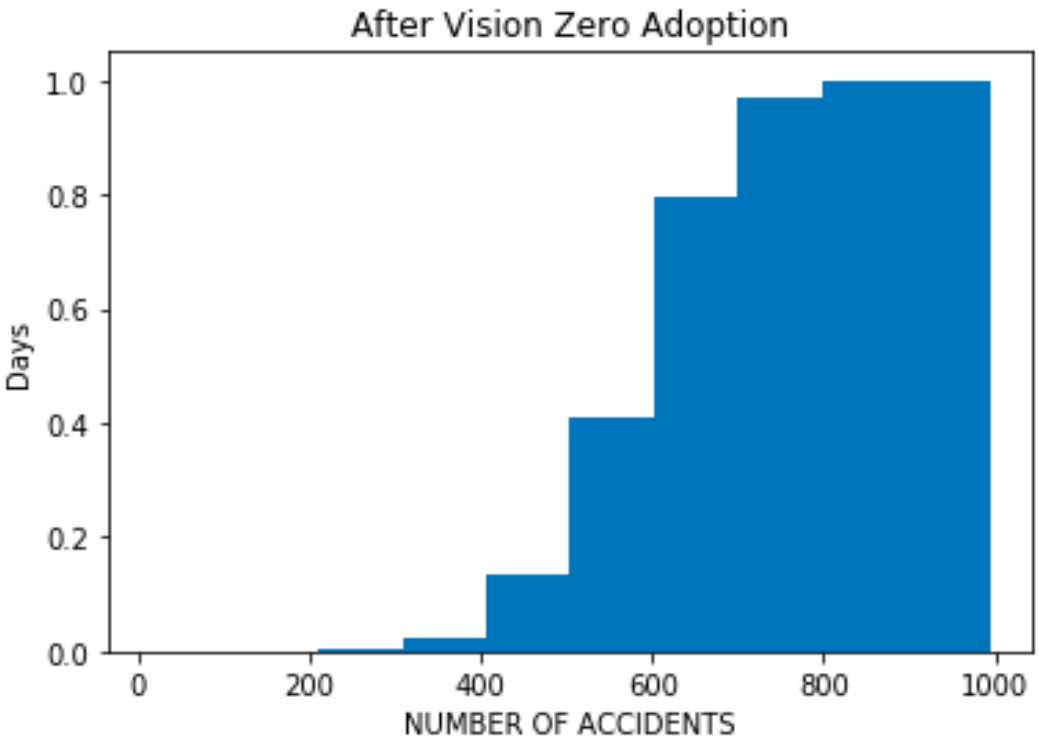

Figure 2: Cumulative Frequency of Daily Number of Accidents After Vision Zero Adoption

Result:

The KS test informs us that there is a significance between the distribution of the data (number of daily accidents) before and after Vision Zero is applied, i.e., we reject the Null Hypothesis. This is based on the resulting p-value of the test which is orders of magnitude less than the chosen significance level ($p = 0.01$). To confirm that this is indeed the case, an Empirical Cumulative Distribution Function (ECDF) is plotted.

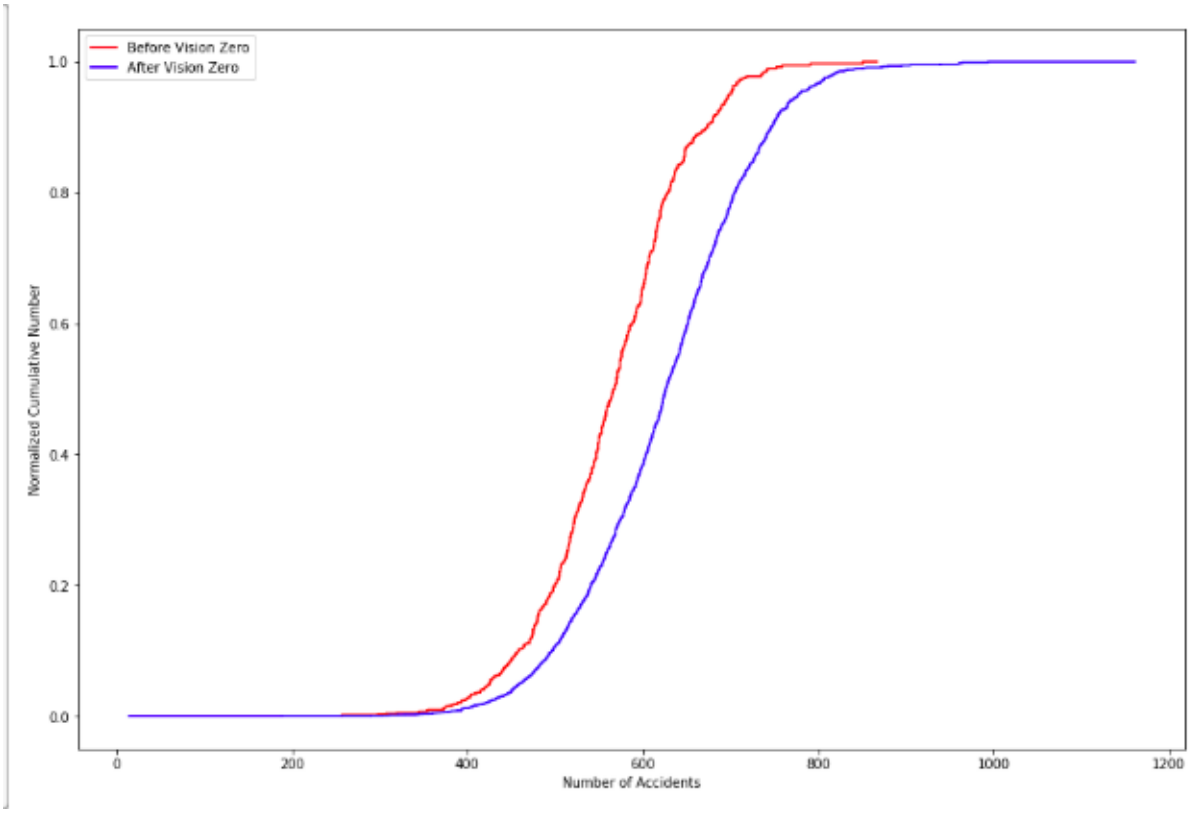

Figure 3: Indicates the differences between before and after the Vision Zero Adoption

From the above figure, it is evident that there is a difference between the two samples. Furthermore, we observe that the number of accidents is greater after the Vision Zero adoption than before the adoption for the same cumulative fraction. This seems to indicate that not only is there a difference between the rate of daily accidents before and after Vision Zero adoption, but there is also an increase in the rate of daily accidents.

To analyze if the point of greatest change in the mean of the daily rate of accidents coincided with the Vision Zero adoption, the following figure is plotted.

From the above figure, we see that the point of change (indicated by the peak) does not correspond to the Vision Zero Adoption Date. This seems to indicate that the Vision Zero Adoption date was not directly

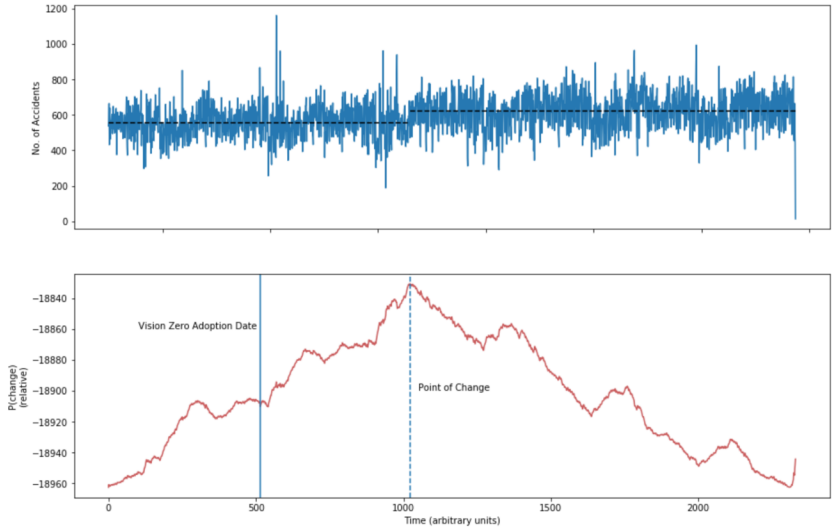

Figure 4: The above figure depicts the mean of the time series before and after the point of change. The figure below it depicts the probability of each point in the time series being the point of change.

responsible for the increase in the rate of daily accidents.

Conclusion

In conclusion, the KS-test indicates an increase in the rate of daily accidents after NYC date of adoption to Vision Zero. The point of change analysis points that the increase in the rate of accidents does not coincide with the Vision Zero implementation date. However, it is difficult to conclude that the implemented policies of Vision Zero were not adequate.

Furthermore, we could presume that they are other factors involved that contribute to the increase in the rate of daily accidents. More and more, the drawn conclusion is that Vision Zero's adoption did not result in a decrease in the rate of accidents as expected. On the contrary, there is an increase in accident; according to the point of change, the policy implementation date does not contribute to the increase.

Note, that there could be an event that occurred around the point of change that might have caused that increase. Further investigation would be necessary to find out if there any such event.

Future Work

Outcomes and Finding

Finding and Mitigation based on reflection the probability the cumulative number of accidents before and after Vision Zero was adopted, there are multiple points to improve data collection.

The following are some recommended mitigation measures:

1. provide an updated survey of the increase of number of vehicles per-year and to provide new mitigation measures
2. Making sure that mobility is safe from the beginning
3. Vision Zero must include human error in both planning, engineering and enforcement

4. A close study based on both characteristic of streets and culture

5. Working closely with all type of vehicles engineers and developers to make sure the safety of vehicles fits with the goal of street safety.

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